



Intel Develops Breakthrough Packaging Technology

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What are we announcing?

- **Intel researchers have developed a new packaging technology for microprocessors**
- **This technology enables higher performance, thinner and lighter packages and lower power consumption**

Packaging technology breakthroughs are a critical element in Intel's plans to build processors with more than a billion transistors, running at about 20 GHz in the next few years

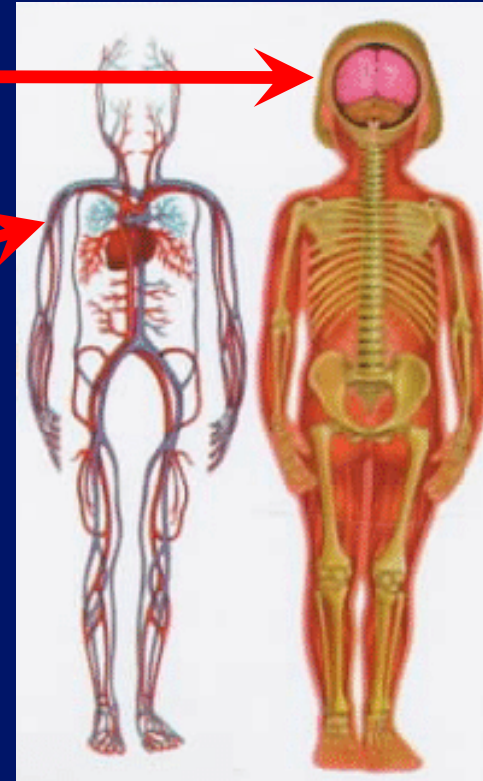
Presentation outline

- Why is packaging important?
- Toward the billion-transistor processor
- Details of BBUL technology
- Summary

Why is packaging important? Helps drive Moore's Law

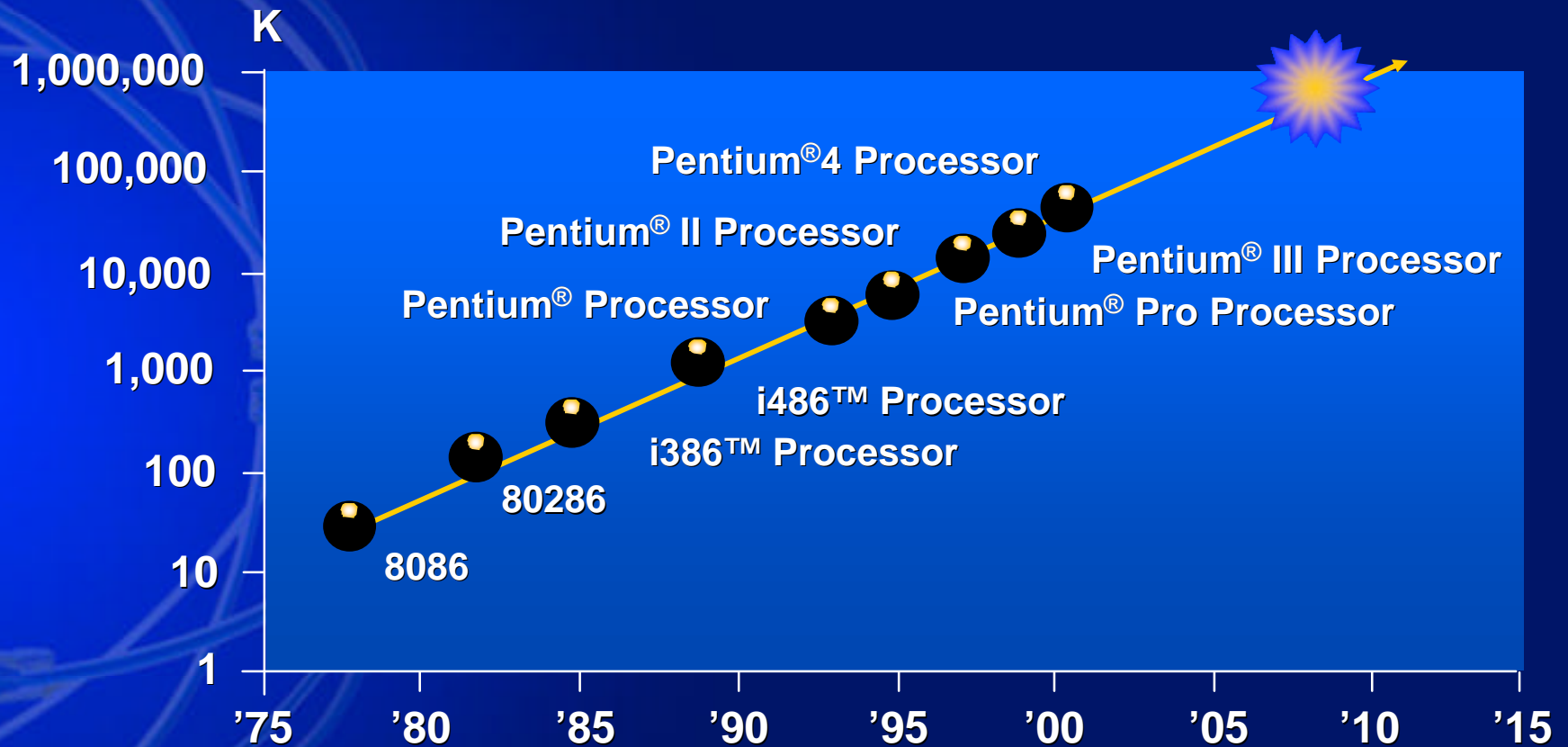
Silicon Processor:
The "brain" of the computer
(generates instructions)

Packaging:
The rest of the body
(Communicates instructions
to the outside world, feeds
power to the processor, adds
protection)



*Fast silicon in a slow package is like putting a Formula
One engine in a compact car and expecting it to run
like a race car*

Heading toward 1 billion transistors



Source: Intel

*Integrated Packaging + Silicon Technology
development is essential*

Need to deliver innovations in several key areas:

- 1. Transistors**
- 2. Interconnects**
- 3. Lithography**
- 4. Packaging**

Intel's silicon research strategy

1. Advanced Transistors

- ✓ Intel has unveiled the world's smallest and fastest CMOS transistors running at 1.5 THz (1500 GHz)

2. Advanced Interconnect

- ✓ Intel is using copper technology and developing new dielectrics to speed up interconnects

3. Advanced Lithography

- ✓ Intel is leading the industry consortium developing EUV lithography and demonstrated first EUV masks

4. Advanced Packaging

- ✓ Intel is developing new packaging technologies that enable higher performance, better power management and smaller size

Packaging complexity and challenges

1. Silicon-to-package interconnect
2. Within package interconnect
3. Power management
4. Adding more functionality

BBUL addresses these issues

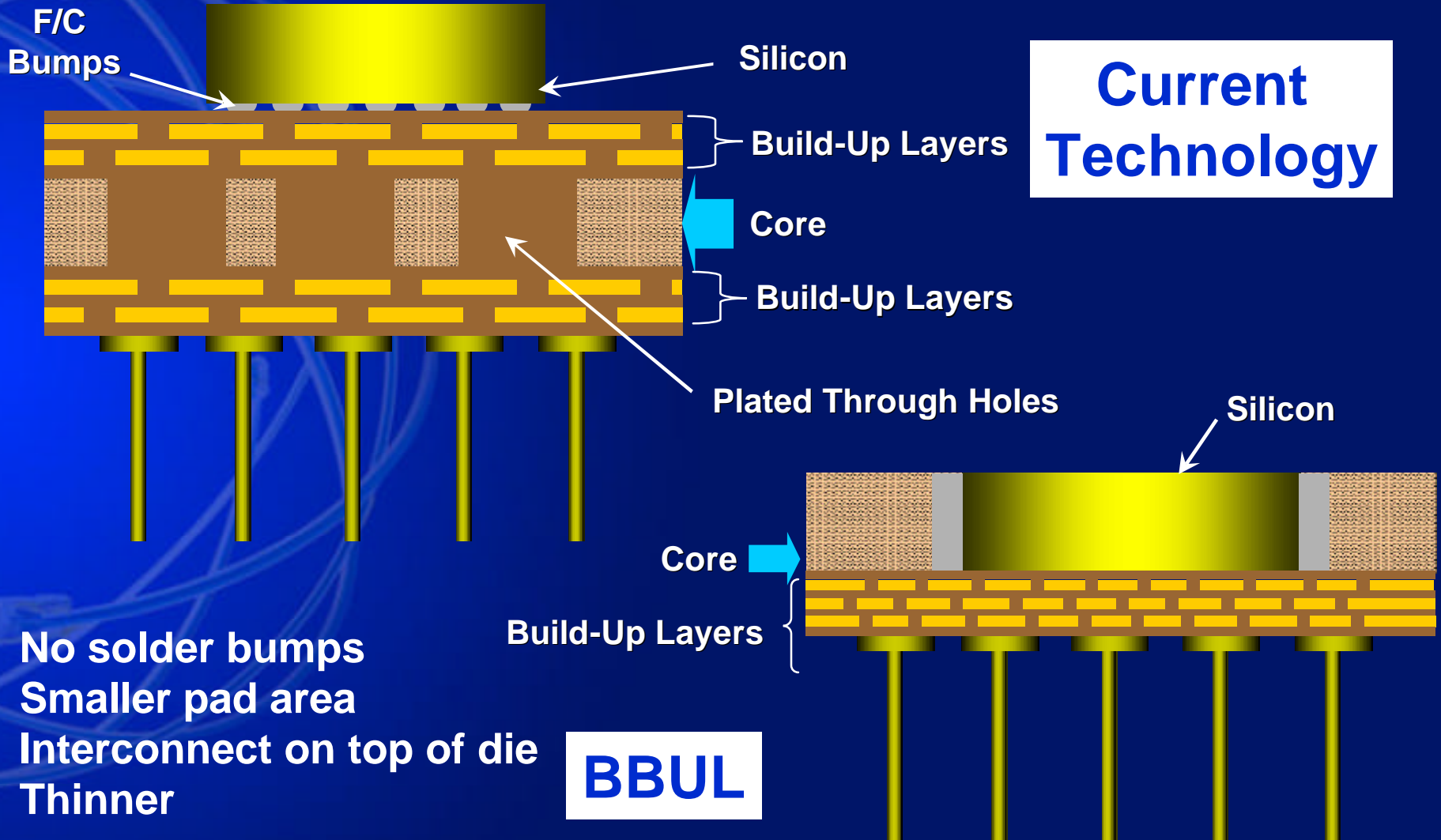
Goal : Bring technology innovation into
High volume manufacturing at a LOW COST

What is BBUL?

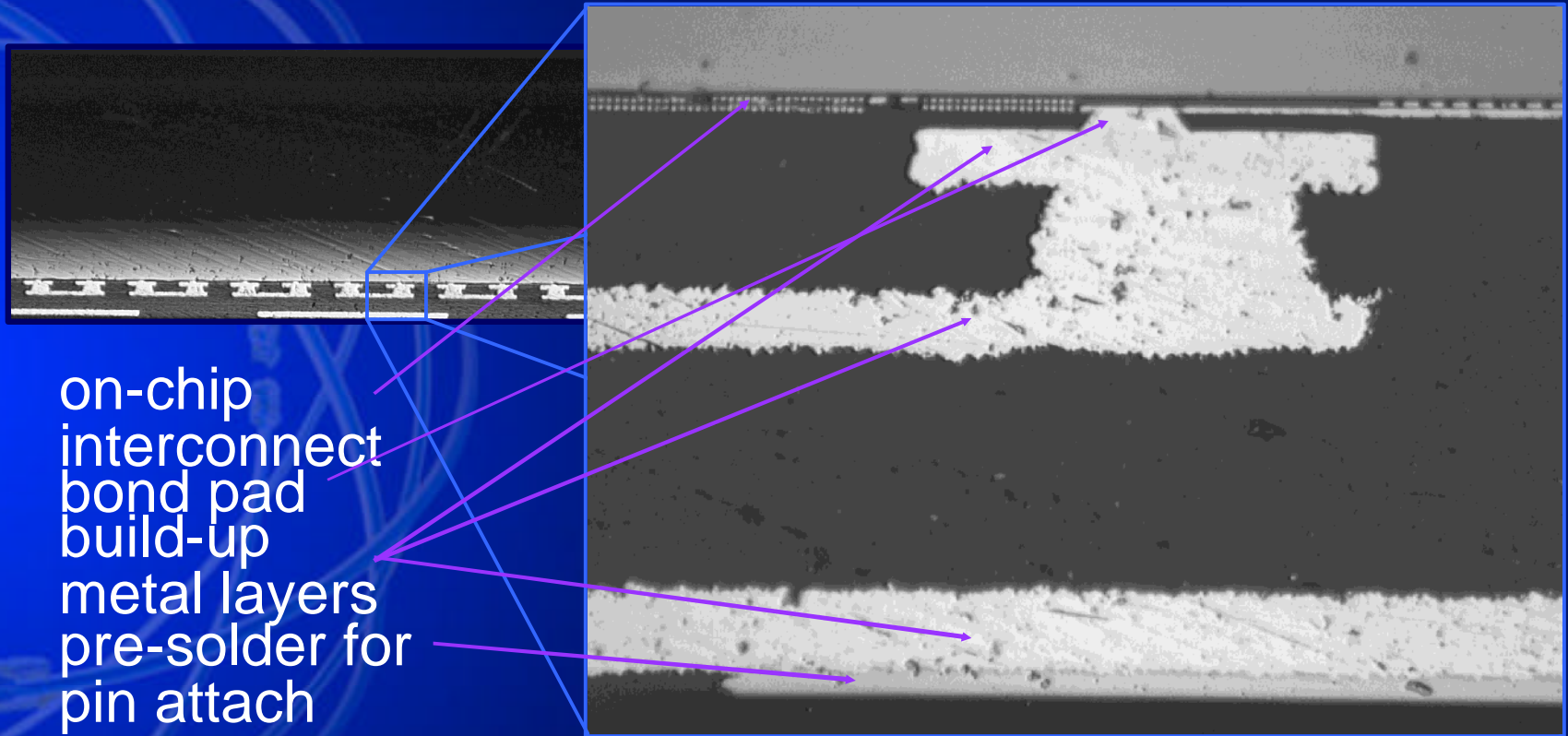
- **B**umpless **B**uild-**U**p **L**ayer
- A novel packaging technology
 - Die embedded in package, not attached to its surface
 - Electrical connection between die and package made with copper lines, not C4 solder bumps
- Key advantages:
 - Thinner and lighter than today's packages
 - Higher performance
 - Allows incorporation of multiple silicon components in single package
 - Can help lower power

Today's Package vs. BBUL Pkg

Physical Attributes Comparison



BBUL package cross section



BBUL package cross section

Package

Silicon
die

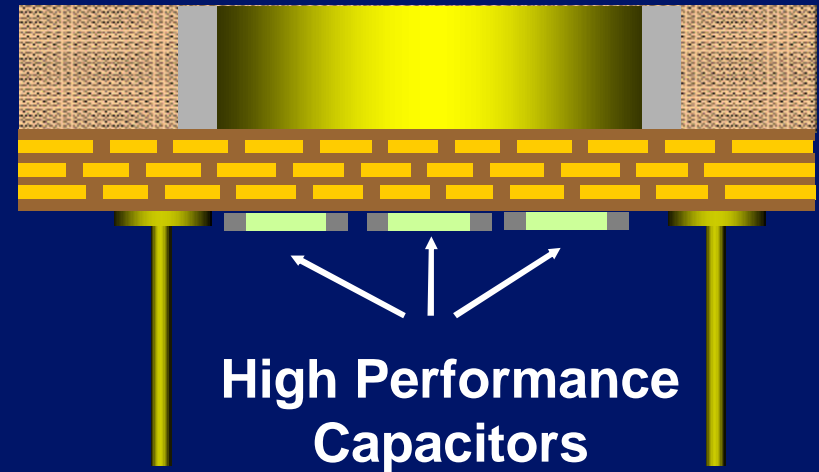
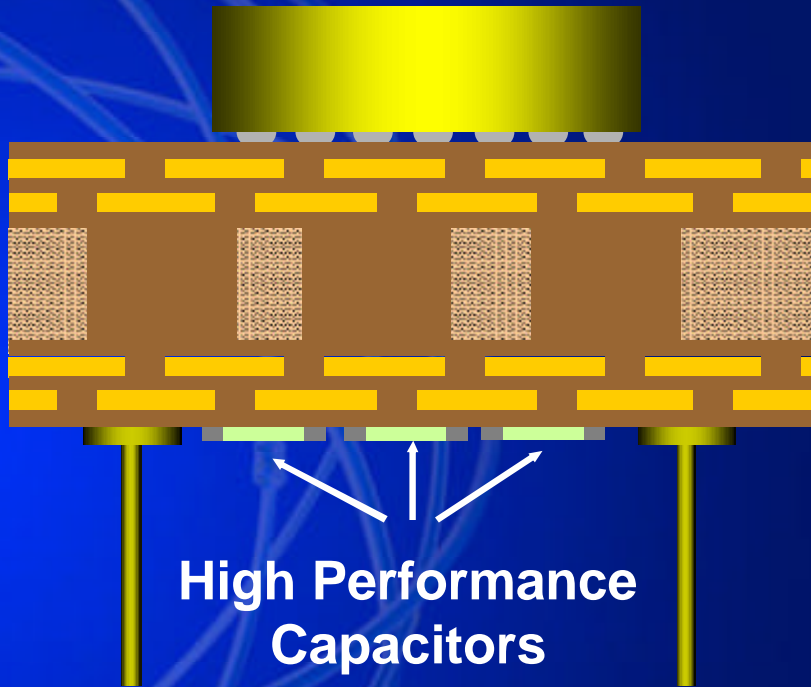


Thinner than a dime

Note: This package has no pins

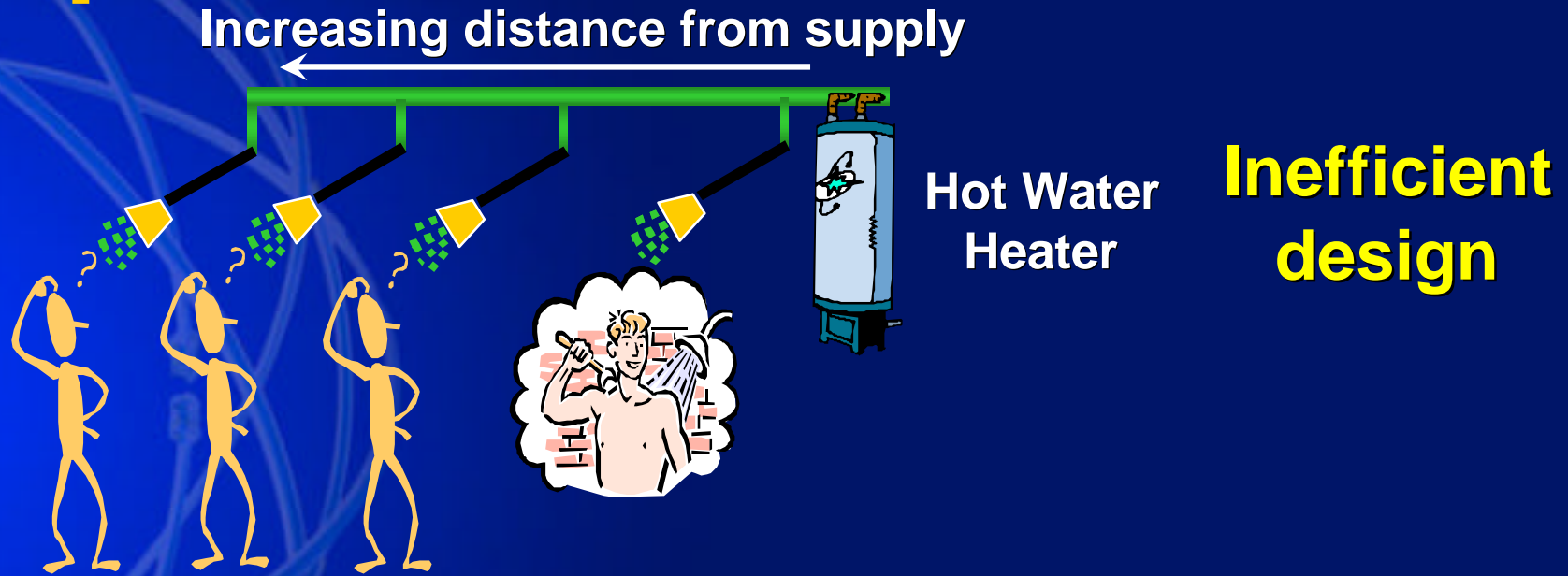
Capacitor placement

Power delivery advantage



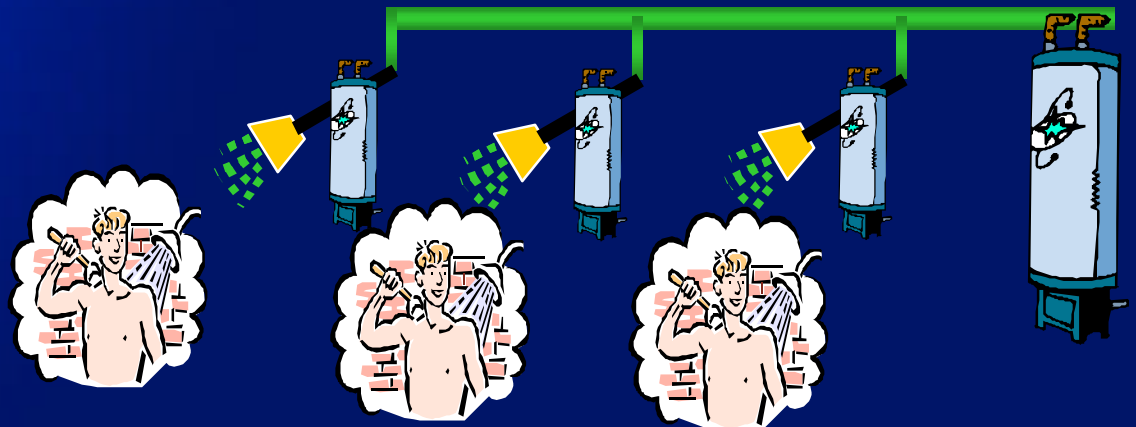
Capacitors can be placed much closer to the die – delivering power where you need it

Why is capacitor placement important?

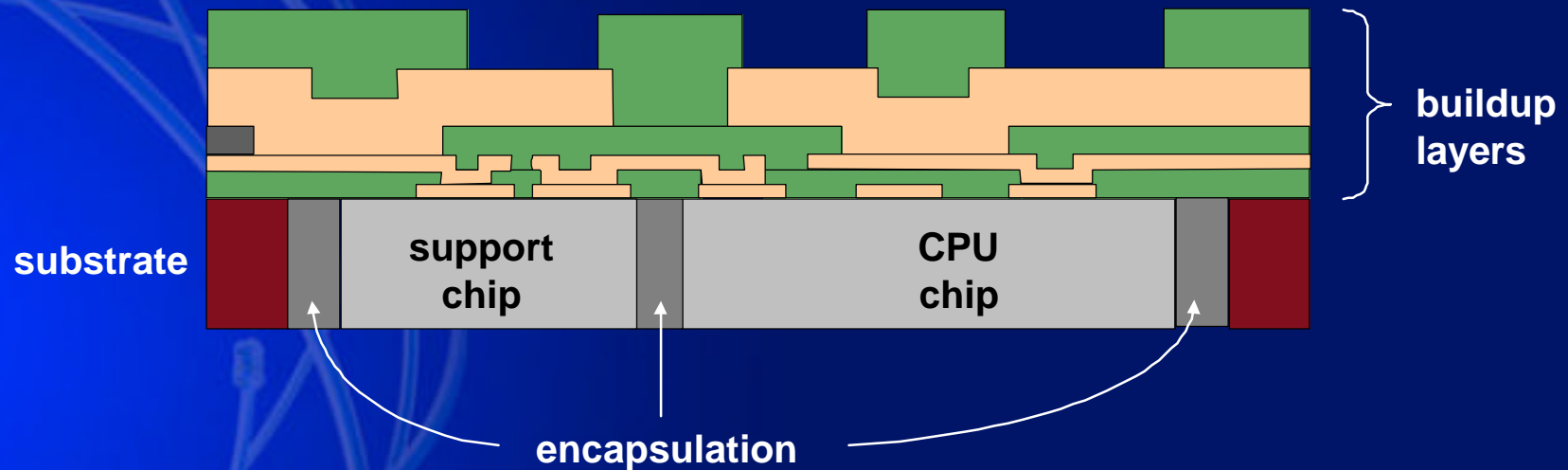


Still Waiting !!

Close Proximity to supply

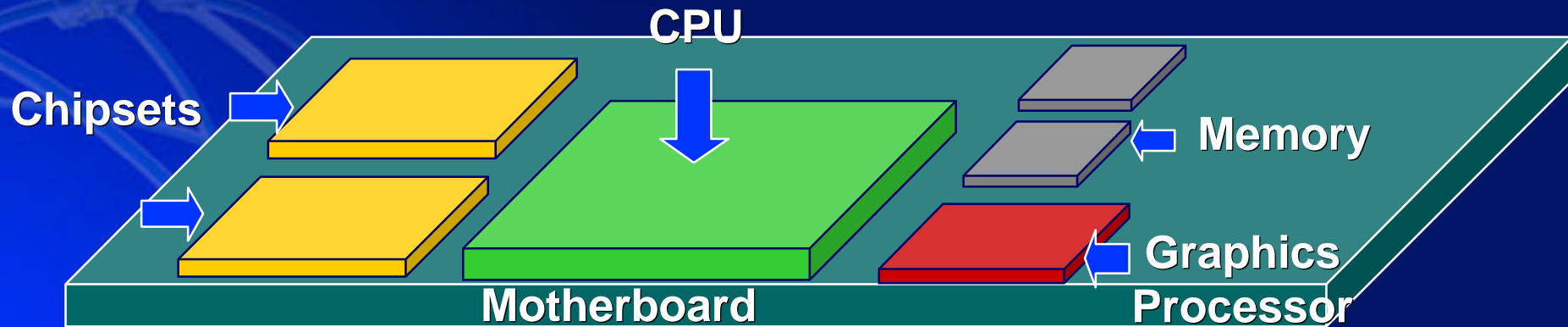


Multi-chip module potential



- High speed multi-chip package
 - Low inductance = better interconnect speed
 - Back side open for more efficient cooling

System-on-a-Package potential



BBUL has the potential to be used to create “system-on-a-package” designs



Summary

- Intel researchers have developed BBUL, a new packaging technology for microprocessors
 - BBUL enables higher performance, thinner and lighter packages and can help lower power consumption
 - BBUL has potential to be used for “system-on-a-package”
- Targeting BBUL as packaging option in 2006 ~ 2007 timeframe
- Intel has leading research in all key areas necessary to deliver 1-billion-transistor processors
 - World's fastest transistors
 - Advanced interconnect technology
 - Advanced lithography (EUV)
 - Advanced packaging technology

Thank You !

For more information, please visit

Silicon
Showcase
Breaking Barriers
to Moore's Law

<http://www.intel.com/research/silicon/packaging.htm>

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